

COSTS OF TECHNOLOGY

Distance-learning costs involve both initial expenditures and ongoing programming and operation costs. For universities and large corporations, which are more likely to establish custom-made telecommunications systems, costs are greater. VSAT networks, commonly used by large corporations for whom maintaining private systems is important, can cost up to \$12,000 per site to install (Carl Girod, PBS, personal communication, June 10, 1994). Most K-12 schools and small businesses are likely to subscribe to an existing telecommunications system, rather than construct an entire ITFS, microwave, fiber optic, or satellite network. Even so, initial expenses can be quite an investment. A 1991 survey of community colleges found that, among the reasons listed for not having a plan for distance learning by 1994, "too expensive to start" and "state provides insufficient funds for distance learning" were the most often cited. Almost one-half of two-year institutions noted the barrier of start-up costs. By comparison, less than 10 percent cited opposition by faculty, administrators, or board of trustees as significant barriers (Brey, 1991).

One of the most universally accessible telecommunication networks is the telephone system, although schools are less likely to have adequate phone lines than are businesses. Even when the network is established and functioning, distance-learning applications can still be quite costly. For example, audio conferencing—which is relatively low cost compared to satellite networks—can cost from \$50 to \$400 for each speaker phone and \$1,000 to \$3,000 per port for bridge equipment. Ongoing costs include maintenance and per-minute telephone charges for long-distance calls. Audiographics systems additionally require graphic tablets, scanners, facsimile machines, and separate telephone lines for data. Audiographics equipment costs can range from \$6,000 to \$13,000 per school (Barker, 1992).

Several sources provide financial, technical, and equipment support for distance learning, including RBOCs, cable companies, and private

foundations. Several large federal programs have also underwritten telecommunications technology acquisitions and services for schools, including the U.S. Department of Education's STAR Schools program, the U.S. Department of Commerce's NTIA grant programs, and programs of the Rural Electrification Administration fund. Other private and federal programs provide limited support for curriculum development, special programming, technical assistance, and related research (for a complete list, see Krebs, 1993).

In recent years, states and local communities have underwritten distance education systems by issuing bonds to cover construction costs; passing legislation to install equipment such as satellite dishes in schools; providing state grants for local projects; and in one instance, levying special taxes on videotape rentals to support distance-learning costs (U.S. Congress, OTA, 1989). In many cases of ITFS, fiber optic networks, or satellite programs, cooperative agreements between school systems and commercial businesses or telecommunications service providers have overcome cost barriers. The trend for ITFS use, for example, is for educational institutions to lease valuable microwave frequencies to commercial wireless cable companies in exchange for equipment and technical assistance.

REGULATORY BARRIERS

All delivery systems for distance-learning services are regulated by state or federal agencies. Two primary industries, the telephone companies and the cable companies, have made commitments to providing a national broadband communications network to schools. Issues surrounding the development of networks—including what types of services will be offered by what industries, what fees can be required of whom, and to whom will access be required—are still being discussed, negotiated, and legislated. The current pending legislation will require the FCC to develop the requirements that can establish universal, affordable rates for education. Distance-learning issues of delivery service integration are of primary concern (Gooler, 1991).

For distance learning that uses these telecommunication networks as a means of delivering nationally produced educational programming and instruction, there are additional concerns about copyrights and viewing restrictions. According to a report from the International Telecommunications Council (ITC):

Current conventions of marketing television courses may be a barrier to their widest use. The course elements and the rights to distribute them are often sold separately. For instance, television programs for most courses are licensed both as a full-credit class and as a set of video programs to be used individually in classrooms. Sometimes the rights to use a course on different distribution systems are marketed independently. These practices confuse the marketplace and may discourage institutions from purchasing or using the courses to their fullest advantage (Brock, 1991, p. 7).

As with all telecommunications applications, copyright and intellectual property rights will continue to be problems for distance learning. "Fair use" definitions have not yet been clearly defined for emerging distance-learning technologies (Brillson, 1993).

TRAINING PEOPLE TO USE LEARNING TECHNOLOGIES

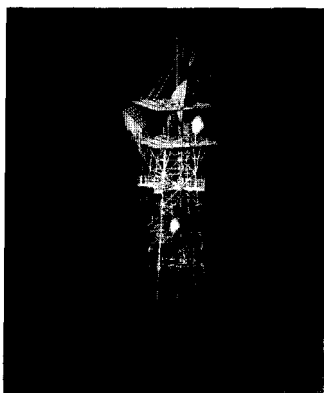
Training is a major issue, particularly for K-12 education, where distance learning is being incorporated by working teachers. Training is now being addressed at all levels, from the local school to the state to the service provider. Schools and systems that make use of distance learning have done an inadequate job of preparing teachers to use the technology well. A case study conducted by OTA indicated that 64 percent of the teachers involved in tele-teaching had not received prior training on the distance-learning systems used, even though many aspects of teaching and learning have to be rethought for distance learning to work well. The role of the on-site facilitator is also critical. In many programs, this person is

responsible for operating the receiving equipment, monitoring student behavior, evaluating homework and classroom assignments, and supervising testing. Nonetheless, many projects provide no systematic training or support to these important personnel (U.S. Congress, OTA, 1989).

According to the American Association of Colleges for Teacher Education (AACTE), only about 20 percent of teacher-training programs offer coursework incorporating current learning technologies. Preservice and inservice training programs should incorporate technology throughout teachers' education, instructing teachers with the same tools they themselves will be expected to use (Portway & Lane, 1992). States are taking the lead in addressing training issues. The State of Alabama, in its attempts to ensure the effective use of learning technologies, established a Teacher Education Scholarship program, which intends that all participants will be able to use and integrate telecommunications, ranging from Internet to satellite programming (McFadden & Johnson, 1993). Tennessee has incorporated teacher training as a prerequisite to technology funding, and most state technology plans include technology training as a primary goal. Many of the STAR Schools program providers routinely incorporate training and professional development activities into their offerings.

COURSE ACCREDITATION

Issues of accreditation for distance-learning courses present new challenges to traditional education. The extent and specifics of these factors vary among K-12 education, higher education, and worker training. Elementary and middle-grade classes do not typically involve formal coursework, nor do most worker training efforts. In higher education, distance learning is most often provided in the form of complete courses that are either originated at and used by the accredited institution, or are nationally distributed courses that go through extensive formal accreditation procedures by the college or university



using the services (compiled from materials received from PBS Adult Learning Service, Coast Community Colleges, and others). In general, accreditation issues are most significant at the high school level, where state-regulated graduation requirements must be fulfilled by specifically approved curricula. A national accreditation system for distance learning has been suggested as one solution to this problem (Schlosser & Anderson, 1994). In addition, implementation of voluntary national content standards called for by Goals 2000 should help define common elements for distance-learning providers.

The focus on experimental learning, individualization, and interdisciplinary content creates many possibilities for creative use of distance learning to enrich traditional instruction, but also opens many points of disputes about the conditions under which distance learning is appropriate and effective. These broad goals and fewer boundaries on content make the K-12 grades particularly challenging for situations in which distance learning is used to enrich classroom instruction. Informal, less structured programming has been a proven factor in improving learning (Tressel, 1994); but such programming often lacks financial and institutional support. Some researchers have called for a reformed curriculum as a crucial factor for incorporating learning technology, suggesting that "to discuss effectively the importance of integrating education technology into the curriculum, it is essential that the traditional focus of curriculum be reframed to accommodate the reform and restructured outlook for schools" (Center for Educational Leadership and Technology [CELT], 1994, p. 67).

COST AND ACCOUNTING SYSTEMS

The challenge in elementary and secondary education is further exacerbated by the accounting systems of most public school systems. In contrast to most colleges and universities, which have cost-accounting systems that relate to specific departments (i.e., the English Department, the Biology Department, etc.), public schools do

accrual accounting, which does not distinguish among various content areas of instruction. Therefore, distance learning often becomes an add-on cost that cannot be equated with traditional costs. Consequently, cost-effectiveness studies are hard to define and measure. Public school cost accounting is merged together, so that it is difficult to analyze costs of different activities, including distance learning. Funding for distance learning, however, almost always includes cost accountability measures (Schlosser & Anderson, 1994). This requirement will increasingly necessitate better cost-accounting systems, which will, in turn, facilitate distance-learning implementation.

Space and personnel costs are also associated with distance learning. Although the distance-learning provider will usually provide the content expertise, in most schools there must be an adult facilitator and, in some instances, a certified teacher. Cost-accounting systems must be employed that give distance-learning providers a per-pupil, per-hour cost that includes a share of the amortized cost of equipment over a lifetime for the equipment, operating and maintenance costs, on-site personnel costs, and housing costs, as well as the actual cost of the distance-learning course and the support services required.

The business community tends to have a clearer sense of cost effectiveness with regards to training resources. A distance learner earning a master's degree on site at her workplace is more cost effective for the company than an employee sent off to college for a period of time. A Federal Aviation Authority radar operator who learns the latest applications of the new radar system on distance-learning workstations at the airport is more cost effective than is one sent away for prolonged instruction. Use of distance learning in the military has proven to be much more cost effective than traditional on-site instruction (Redding & Fletcher, 1993). Colleges and universities—because they charge tuition—are also more likely to have cost-accounting systems that differentiate among different instructional efforts than are public schools.

INSTITUTIONAL STRUCTURES

All education is local in nature, whether it is in the public school classroom, the shop floor, or the local community college. K-12 education, however, involves an enormous bureaucracy in which state and local authorities maintain control over public school activities. Planning for distance-learning use is often complicated as a result.

One example of this complexity is the critical issue of teacher certification. Often, a distance-learning teacher of a high school course that is used in many different states must be certified in each state in which viewing students reside (Schlosser & Anderson, 1994). For higher education, certification is less of an issue because instructors are usually working professors whose credentials are more likely to be universally accepted (Holt, 1992). In the workplace, teacher certification is not as relevant, although qualification of instructors is certainly a universal issue.

Although distance learning has been used for decades, it is still fundamentally different from the traditional classroom-based instruction that remains the model of American education. Many challenges are faced by distance-learning providers who attempt to extend classroom walls. Perhaps most critical, the current organizational structure of both educational institutions and businesses often prohibits effective planning for nontraditional methods. Distance learning involves a combination of expertise in technology, content, and instructional design; and few institutions offer opportunities to bring this expertise together (Schlosser & Anderson, 1994). This lack of "distance-learning-friendly" institutional structures has often been blamed for inadequate planning, a major barrier to successful implementation of distance learning (U.S. Department of Education, 1993). As technologies become more integrated, content and instructional design issues become more complicated. Good distance-learning programs, therefore, will increasingly require effective communication among the various players.

State governments have begun to take increas-

bringing together the necessary diversity of expertise (Schlosser & Anderson, 1994). This positive step not only can help coordinate activities, but help avoid incompatible or duplicate efforts. State technology plans increasingly include business and industry in collaborations with schools, universities, and community organizations. State organizations are also helping to accommodate issues of local autonomy. The Massachusetts Corporation for Educational Telecommunication's STAR Schools program is providing a menu of programming and technology from which local districts can choose services that best meet their particular needs (Schlosser & Anderson, 1994).

PROGRAMMING QUALITY

Among the many distance-learning delivery systems, a large portion of services are video based. Modern distance learning has its roots in televised lectures. As these services evolved to include better audio and video quality and more interactivity, the role of an on-screen teacher has become better understood as a unique characteristic of distance learning. High-quality, distance-learning programming depends on good on-screen instructors. An effective on-screen presence requires different skills from those of traditional teaching. In the workplace, although formal certification is usually unnecessary, the quality of instruction is recognized as important but often not appropriately designed for the target audience. One researcher noted: "Too frequently, the training function is conducted by a content expert who is not an adult education facilitator" (Portway & Lane, 1992, p. 288). Experts in the field at all levels agree that the abilities of the on-screen instructor are crucial and that such methods require particular skills (Minninger, 1993). An on-screen instructor must be organized, be able to pace the lesson effectively, and recognize what materials are appropriate for video. For programs that take fuller advantage of the medium by using taped video inserts or computer graphics, the instructor

Roles vary greatly, depending on the program format. In some cases, the instructor is the producer, director, and floor crew all in one. More high-production value formats may use a full studio facility and support staff, requiring only that the instructor work well in a studio setting (Holt, 1992). The qualities of an excellent distance-learning instructor extend well beyond a firm grasp of subject matter and an engaging style.

AWARENESS AND ACCEPTANCE

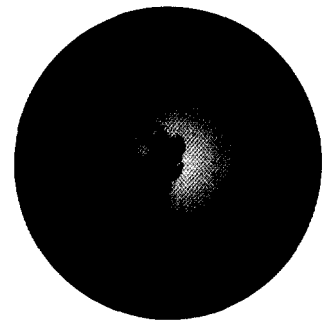
The myth that distance learning is a second-rate alternative to traditional instruction is, unfortunately, still prevalent in all sectors of education and training (Lane, 1993; Steele, 1993). At the elementary and secondary levels, lack of acceptance of distance learning has been an issue partly because of the circumstances under which it was introduced into American schools. Schools turned to distance education most often when qualified teachers were in short supply in critical content areas, when teachers could not be attracted to distant or rural areas, and when the number of students needing or interested in particular courses was too small to support a teacher's salary (U.S. Congress, OTA, 1989). Thus, distance learning often is seen as an alternative to hiring teachers and, in some circles, was promoted as a more cost effective way of providing instruction in certain subject areas, raising concerns among educators about how large-scale use of distance learning would affect levels of teacher employment and responsibility. Such concerns still fuel resistance in schools.

For K-12 schools in particular, a "not developed here" syndrome often prohibits ready acceptance of distance-learning resources. This may be a deciding factor for school districts that choose to establish "closed" ITFS or satellite networks, in which local resources are shared within a few districts or counties. The ability to maintain local control of the instructor, programming, and scheduling has been cited by some as a significant advantage to using audiographics-based systems instead of nationally distributed satellite program-

ming (Barker, 1992). Staff working on the STAR Schools TEAMS program, which serves thousands of students nationwide, cite this as a persistent barrier, noting the need for a local feeling of ownership and participation in the program (Don Lake and Frank Withrow, personal communication, August 1, 1994). In this respect, some regional or local networks for K-12 distance learning are similar to private networks used by many businesses, who may prefer to maintain stricter control of industry-specific course content (Portway & Lane, 1992).

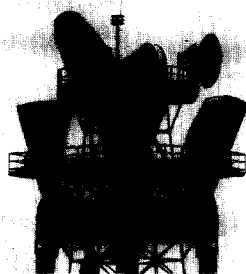
For some educators, distance learning is equated with television, which, despite research to the contrary, has been persistently criticized as having a negative influence on learning. This belief results in an underestimation of video-based instruction as a learning tool, particularly for children. Thus, distance learning has been used most often for more self-motivated learners. These attitudes are rapidly changing, and funding programs such as the federal government's STAR Schools program are bringing distance learning to K-12 students and underserved populations (Schlosser & Anderson, 1994). In the workplace, business television networks have acquired a proven track record of providing high-quality, cost-effective training (Lane, 1993).

Limited awareness of new developments also may contribute to negative impressions of distance learning among educators not familiar with the varied instructional and technological formats available today. Many educators and students formed impressions of distance learning when it was little more than broadcasts of an instructor addressing a regular classroom, employing one-way video and audio, poor quality monitors, no interactivity, and delayed evaluative feedback for students. The reality of today's distance-learning programs provides a wide array of interactive options and feedback systems that are increasingly easier to use, easier to watch, and less expensive. More important, they provide the ability to tailor instruction and allow students to construct their own knowledge through different modes of learning.



CONCLUSION

Much of this chapter has focused on barriers to effective distance-learning use in K-12 education. Although distance learning may offer the means of transforming K-12 education in ways that broaden access to education and support critical elements of current reform efforts, challenges here may be more numerous and more daunting than in other education settings. Clearly, the potential for distance learning to upgrade the nation's work force and ensure lifelong learning is equally important and also relatively untapped. Many of the barriers faced by users of distance learning, such as lack of acceptance and instructor qualification, are universal issues. Some barriers faced by K-12 education, such as cost accounting and budgeting structures, have been addressed by higher education and business. As the field evolves to integrate more resources, and collaborative efforts increase, distance-learning users at all levels can learn from the ways in which other organizations have overcome obstacles to successfully meet learning needs.



RECOMMENDATIONS

An interconnection of computer networks, telecommunications services, and applications, the National Information Infrastructure can open up new vistas and profoundly change much of American life, not by the fact that it exists but by the way it is used.

Ronald H. Brown, U.S. Secretary of Commerce, May 3, 1994

During the past decade, we have seen a wondrous explosion of technological innovation that has begun to change the way that we live and work. But these developments will no doubt pale in comparison with the changes that are likely to occur within our society in the next five years. In particular, technology will change the ways in which we educate our students . . . how teaching and learning will take place.

Richard Riley, U.S. Secretary of Education, May 9, 1994

The challenges of the information age require lifelong learning for all citizens; and, as we have seen in this report, distance learning has an essential role in meeting this need. This report has described the wide array of distance-learning resources available in schools, colleges, homes, and workplaces. The examples represent both traditional and innovative applications of telecommunications technology. Important advances in using distance learning have been made, but significant barriers continue to prevent the widespread use of effective distance learning. The following recommendations have been developed, within the nation's plans for the National Information Infrastructure (NII), to overcome these barriers and realize full use of distance learning to achieve the National Education Goals. These recommendations are nationwide in scope and, therefore, general rather than specific to particular states, localities, institutions, or businesses. They encompass an essential principle for the development of distance learning; namely, that such development requires combined private and public action through federal, state, and local education agencies; private industry; and distance-learning service providers.

Recommendation 1: Education agencies at all levels must support the development and use of distance-learning resources to achieve the National Education Goals.

America's National Education Goals set, for the first time, bold expectations for student achievement, from school readiness to adult literacy. Content and student performance standards, assessment strategies, and professional development for teachers provide the building blocks for achieving these Goals. Distance-learning resources are essential for the provision of student opportunities to achieve the Goals.

Recommendation 2: Education agencies at all levels must ensure equitable access to distance-learning resources to increase the opportunity for all citizens to learn.

The capacity to use information technologies is an economic imperative for the work force of the 21st century. Attainment of this capacity by some, but not all, of our citizens is widening the gaps of opportunity for employment and civic and earning power. Distance-learning technologies have the capacity to reach underserved learners; they promise to further increase lifelong

learning opportunities. To provide potential for all citizens, state and federal education agencies must plan for distance-learning resources that overcome inequities of access to technology outside education institutions.

Recommendation 3: The telecommunications industry, distance-learning service providers, and regulatory agencies must support and develop distance-learning delivery systems and information networks that are compatible, interoperable, and cost effective.

A major barrier to increased use of distance learning is the lack of connections among platforms and delivery systems. It is essential that standards of interoperability be established for these technologies to continue to be used for education and training. The developing NII combines public and private resources. Business and industry must work together to create mutual systems that enable the users to function across platforms, ensuring all educational environments convenient access to distance-learning technologies. The increasing potential for integration of telecommunication technologies must be at the center of distance-learning plans.

Recommendation 4: Federal and state governments, together with local communities, educational institutions, the telecommunications industry, and business and industry, should promote public/private partnerships for distance learning and support regional and statewide applications of distance learning as part of an integrated national resource

Cooperation is essential to achieve cost effectiveness through economy of scale across regions and states, to reach larger constituencies, and to encourage better education and training at all levels. The development of distance-learning systems must be comprehensive and serve schools, colleges, museums, libraries, community facilities, and hospitals in efficient ways with high-quality programs provided by diverse providers. Multiple use of distance-learning technologies should be designed for the widest

range of users possible. This will yield cost savings and greater accessibility.

Recommendation 5: State and federal regulatory agencies must develop policies that ensure affordable rates for the educational uses of telecommunications resources. Regulatory agencies having appropriate responsibilities should ensure availability of universal telecommunications services for all levels of lifelong learning and maintain reasonable fair-use copyright guidelines for instructional materials used in distance learning.

State and federal regulatory agencies should develop policies and procedures for telecommunications that favor education and training opportunities. Regulatory standards across the nation must provide for affordable educational uses of the telecommunication networks that deliver distance learning. Intellectual property rights are increasingly important issues for distance learning, and evolving regulations should maintain the concept of fair use for educational purposes.

Recommendation 6: Federal and state agencies, in cooperation with the private sector, should develop new resources for investment and capital development for distance learning. Support from federal agencies must be coordinated to provide efficient and effective funding uses.

High-quality distance-learning resources require significant new investments. Private sector and public resources must be coordinated to ensure a sound mix of support for research, development, and distribution of distance-learning products. Equally important is the need to coordinate federal funding capacities toward highest priorities and leverage efforts for system expansion.

Recommendation 7: Professional development programs for educators and administrators should rely increasingly on distance learning and include technical training for the use of distance learning in formal education programs.

It is obvious, but important to report, that



effective use of distance learning requires appropriate training. Such training should be comprehensive and designed so that select staff will become distance-learning instructors, as well as users of distance-learning resources, to enable a pyramid growth effect. Most educational practice now is organized around textbooks and classroom presentations. Learning technology applications must enable teachers and instructors to handle telecommunications technologies as the educational tools of the information age.

Recommendation 8: State education agencies must improve course accreditation procedures to advance the use of distance learning and other alternative education offerings.

The delivery of quality learning to locations where most needed is a primary objective of distance learning. This service does not and should not stop at state boundaries. Unfortunately, state-by-state course-accreditation practices are a significant barrier to the effective use of distance learning for high school graduation requirements. Bilateral and multilateral or regional agreements among states must evolve to accommodate new teaching and learning techniques and provide appropriate quality assurance.

Recommendation 9: Providers of distance learning must develop cost-accounting standards that provide accurate information on unit-of-instruction costs and instructional effectiveness assessments for distance learning.

Most school systems, colleges, and even business training programs lack cost-accounting structures that allow for accurate analyses of the comparative impact of innovative learning and teaching models. Accounting standards should be adopted that accommodate alternative educational resources such as distance learning. Appropriate unit cost data are needed to make evaluations of the instructional cost-effectiveness. Cost-effectiveness evaluation of distance learning requires both appropriate cost-accounting structures and precise assessments of learning effectiveness.

Recommendation 10: Education institution authorities planning to use or expand distance learning must take special actions to create organizational environments for undertaking the values and limits of the service for the desired effects to be realized.

Collaboration among technical experts, educators, instructional design specialists, and resource managers is critical for effective planning and implementation of distance learning. Creating environments in formal education and the workplace that bring together such teams of individuals is a key factor in overcoming outmoded practices. Here again, the point is obvious; but the task must not be underestimated and must be explicitly planned and budgeted.

Recommendation 11: Distance-learning providers and users must join forces to strengthen distance-learning content requirements and instructional formats.

State education agencies are actively developing and implementing comprehensive content and student performance standards to meet the National Education Goals. Distance-learning service providers must use these standards and change products for schools and workplaces. Distance-learning providers have a special advantage in incorporating new standards into their courses and instruction and, thereby, lead the reforms. They must capitalize on this advantage. State and local education agencies, teachers and instructors, and individual home-learners are more likely to use distance-learning services that meet learning goals.

Recommendation 12: Local, state, and national authorities should undertake awareness and outreach activities to inform educators, business and industry, and the public of the value and importance of distance learning to achieve the National Education Goals.

A significant barrier to widespread use of distance-learning technologies is a lack of awareness and acceptance of distance learning as an effective and valuable option for education and

The effective use of distance learning to meet the National Education Goals requires combined private and public action through federal, state, and local education agencies; private industry; and distance-learning service providers.

training. Educators and the general public must have an understanding of not only the role of distance learning in improved education, but the ways in which it can be a cost-effective learning resource. The importance of distance learning to basic education, school-to-work transition, worker training, individually tailored learning, and enhanced opportunities for lifelong learning for all citizens must be made clear. Public discussion of issues related to the developing NII provide a timely context for distance-learning awareness efforts.

Summary

These recommendations are based on assumptions that the technologies involved with distance learning are on a course of convergence, and that this convergence relates to wired and wireless broadband digital voice, data, and video transmissions. Effective development calls for new structures that take advantage of the developing technologies and allows a full range of freedom in developing competitive learning technologies. This new highway of information will significantly increase the potential for distance learning to meet the National Education Goals. The federal government, therefore, should work in partnership with state and local entities, private sector communications industries, institutions of higher education, and the public to ensure that all citizens have access to the broad array of resources that are a part of the nation's treasure. Widespread access to distance-learning resources is an important facet of the opportunity for lifelong learning that is an integral part of these initiatives and a necessity for the 21st century workplace.

We hope that this report and its recommendations will encourage the growth of distance learning in this country. Distance learning has evolved from simple correspondence and one-way television broadcasts to an almost unimaginable array of interactive technologies and applications, many of which have been described in this report. However, significant barriers must be overcome if distance learning's potential is to be fully realized. As these recommendations make clear, greater

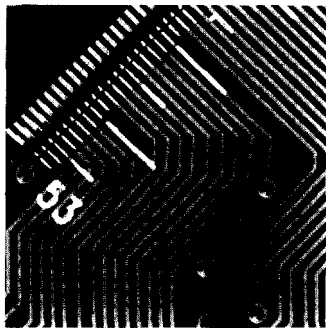
technologies, increased cooperation, and shared use of facilities are all important to the cost-effective, widespread use of distance learning. As distance learning becomes a basic resource available to all learners, it can help guarantee all Americans lifelong opportunities for education and training. The development of distance learning is essential to achieve our National Education Goals.

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AACC	American Association of Community Colleges
AACTE	American Association of Colleges for Teacher Education
ADSL	asymmetric digital subscriber line
AG*SAT	Agricultural Satellite Corporation
ALS	Adult Learning Service of PBS
ALSS	Adult Learning Satellite Service of PBS
ASTD	American Society for Training and Development
ASU	Appalachian State University
ATV	advanced television
BCSN	Black College Satellite Network
CCC	Coastline Community College in Orange County, California
CCSN	Community College Satellite Network
CCSSO	Council of Chief State School Officers
CELT	Center for Educational Leadership and Technology
CETN	Central Educational Telecommunications Network
CNN	Cable News Network
CTN	Community Telecommunications Network—Detroit, Michigan
DBS	Direct Broadcast Satellite
DoDDS	Department of Defense Dependents Schools
EFF	Electronic Frontier Foundation
ETV	Educational Television
FCC	Federal Communications Commission
GED	General Equivalency Diploma
HBCU	historically black colleges and universities
HDSL	high-bit-rate digital subscriber line
HDTV	High-definition television
HEC	Higher Education Consortium for Distance Learning—Massachusetts
IEA	International Educational Assessment
IPS	Indianapolis Public Schools
IREAD	Indianapolis Regional Economic/Academic Development—Indiana
ISDN	integrated services digital network
ITC	International Telecommunications Council
ITFS	Instructional Television Fixed Service
KET	Kentucky Educational Television
LAN	local area network
LEAP	Project LEAP—Mississippi
LPTV	Low power television
MCET	Massachusetts Corporation for Educational Telecommunications
MDR	Market Data Retrieval
ME/U	Mind Extension University
NAU	Northern Arizona University
NCC-TET	National Coordinating Committee for Technology in Education and Training
NCTA	National Cable Television Association
NCTM	National Council of Teachers of Mathematics
NII	National Information Infrastructure
NIST	National Institute of Standards and Technology

NTIA	National Telecommunications and Information Administration
NTU	National Technological University
NYNEX	New York/New England telecommunications system
OERI	Office of Education Research and Improvement
PBS	Public Broadcasting Service
PCS	personal communications services
PTFP	Public Telecommunications Facilities Program
PTV	public television
PUC	Public Utility or Service Commission
RBOCS	Regional Bell Operating Companies
RETN	Regional Educational Television Network—Vermont
SCANS	Secretary of Labor's Commission on Achieving Necessary Skills
SCOLA	Satellite Communications for Learning Association
SECA	Southern Educational Communications Association
SERC	Satellite Educational Resource Consortium
STEP	Satellite Telecommunications Educational Programming—Washington State
SWRL	Southwest Regional Educational Laboratory
TCI	TeleCommunications, Inc.
TEAMS	Telecommunications Education for Advances in Mathematics and Science—Los Angeles
TI-IN	Texas Interactive Instructional Network
TIIAP	Telecommunications and Information Infrastructure Assistance Program
TLC	The Learning Community—Massachusetts
TOC	Technical Operating Center of CTN
USDLA	United States Distance Learning Association
USEN	U.S. Educational Network
USSB	United States Satellite Broadcasting
VCR	videocassette recorder
VSAT	Very Small Aperture Terminals
WLAN	wireless local area networks
WPR	Wisconsin Public Radio



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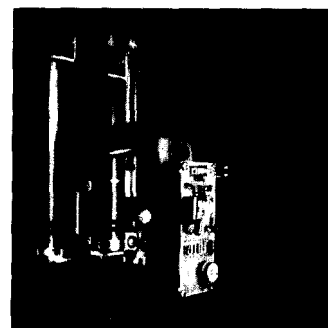
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